O K L A H O M A S T A T E U N I V E R S I T Y

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING

ECEN 5713 Linear Systems
Fall 2002
Midterm Exam #1

Choose any four out of five problems,
Please specify
1)_____; 2)_____; 3)_____; 4)_____;

Name : _____

Student ID: _____

E-Mail Address:_____

Problem 1:

Suppose it is known that a linear, continuous-time system has impulse response given by $h(t,\tau) = \exp(-|\tau - t|)1(t - \tau)$, where $1(\cdot)$ denotes a unit step function. Is this system causal ? Is it time-invariant ? Justify your answer.

Problem 2:

Find the *observable* canonical form realization (in minimal order) from SISO continuous-time system given below:

$$5t^2\ddot{y}(t) + (t-1)\dot{y}(t) + e^{-2t}y(t) = 2\ddot{u}(t) + 3t\dot{u}(t) + t^2u(t).$$

Notice that gain blocks may be *time* dependent. Show the state space representation and its simulation diagram.

Problem 3:

Find the *observable* canonical form realization (in minimal order) from SISO discrete-time system given below:

$$y(k+3) + 3ky(k+2) + e^{-k}y(k+1) + y(k) = k^2 u(k+3) - (k+1)u(k+1).$$

Notice that gain blocks may be *time* dependent. Show the state space representation and its simulation diagram.

Problem 4:
Find an minimal controllable canonical form realization for the following system

$$H(s) = \begin{bmatrix} \dfrac{2s}{s^3 + 6s^2 + 11s + 6} \\ \dfrac{s^2 + 2s + 2}{s^4 + 6s^3 + 9s^2 + 4s} \end{bmatrix}.$$

Note A is a 6×6 matrix

Problem 5:
Let

$$H(z) = \begin{bmatrix} \dfrac{z+2}{z^2+z} & \dfrac{z}{z^2+z} \\ \dfrac{1}{z^2+2z} & \dfrac{z+1}{z^2+2z} \end{bmatrix}$$

be a transfer function matrix. Find a minimal realization (i.e., simulation diagram and state space representation) for the discrete-time system represented by $H(z)$.